

**PHARMACOGNOSTICAL, PHYTOCHEMICAL AND
PHARMACOLOGICAL REVIEW ON CASUARINA EQUISETIFOLIA
LINN**

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ABSTRACT

Casuarina equisetifolia: A fast growing evergreen tree, is a well known xerophytic plant of the tropics and subtropics region. It is endemic to costal area and is native from Australia. Many of the scientific studies have reported that it contains the following primary and secondary metabolite such as carbohydrates, alkaloids, proteins, glycosides, saponins, phenolics, flavonoids, tannins, steroids, gum, reducing sugars and triterpenoids. Casuarina contains a highly oxygenated pyrrolizidine alkaloid casuarine. Phenolic compounds are isolated from casuarina include gallic acid, Ellagic acid, epicatechin, proanthocyanidins, procatechuic, p-coumaric, chlorogenic acid, catechin. Ethnomedicinal uses of casuarina were scientifically

evaluated for antimicrobial, antidiabetic, antioxidant, cytotoxic, hypolipidemic, gastroprotective, hepatoprotective and woundhealing properties. This paper will highlight the Phytochemical, pharmacognostical, pharmacological characters along with the synthesis of silver nanoparticles from *Casuarina equisetifolia*.

KEYWORDS: Casuarinaequisetifolia, Pyrrolizidine Alkaloids Casuarine, Antidiabetic, Silver Nanoparticles.

INTRODUCTION

Plants produce a large number of natural products. These compounds have greater contributions in human health function. Plants are important source for the discovery of new lead molecule. Plants especially those with ethnomedicinal use have been the major source of medicine for early drug discovery. *Casuarina equisetifolia* belongs to the order Casuarinales, a distinctive group of angiosperms class of woody vascular seed plant like conifer. *Casuarina equisetifolia* is evergreen tree with dropping branches. In this plant, actinomycetes helps to fix nitrogen in the roots, Both plant and actinomycetes gets complementary to each other this type of relationship is called as symbiotic. This plant also grows in various environment condition and can withstand natural calamities. India is one of the largest cultivator of *Casuarina equisetifolia* all over the world. The plant has been originated from Australia, Southeast Asia and Polynesia. It contains many active metabolites includes carbohydrates, alkaloids, proteins, glycosides, saponins, phenolics, flavonoids, tannins, steroids, gum, reducing sugars and triterpenoids.^[1]

Synonym

Casuarina litoria Rumph.,

Casuarina littoralis Salisb

Casuarina littorea

Vernacular Name

English; Australine pine, Beefood, Jau, Whistling pine

Hindhi; jangli-Thau, Jangali-saroo

Kannada; Cabaku, Chabuku, Gali, Sarvemara

Malayalam; Cavokku, Chulamaram, Cola,

Marathi; Janglisaru, sarova, sura

Tamil; Savakku maram, Kettivanci, Utirppakam,

Telgeu; Cauku, chavuku, sarugudu, saravu

Classification

Kingdom: Planate

Subkingdom: Tracheobionta

Superdivision: spermatophyte

Division: Magnoliophyta

Class: Hamamelididae

Order: Casurinales

Family: Casurinaceae

Genus: Casuarina

Species: Equisetifolia

Distribution

The family is native from Australia, with extensions into southeast Asia, India, New Guinea, Mascarene Island, New Caledonia, There are four cultivated species of casuarinas viz., *Casuarina equisetifolia*, *Casuarina glauca*, *Casuarina cunninghamiana* and *Casuarina junghuniana*. In Tamil Nadu, this tree is mainly grown in districts of Cuddalore, Villupuram, Kancheepuram, Tiruvallur Thanjavur and Ramanathapuram. It could also be seen on sandy soils of inland districts.^[2]

Description

Evergreen tree to 46 m (150 ft) tall, usually with single trunk and open, irregular crown. Bark reddish brown to gray, rough, brittle, peeling. Branchlets pine-needle-like, grayish green, jointed, thin (< 1 mm wide), 10-20 cm (4-8 in) long, minutely ridged, hairy in furrows. Leaves reduced to tiny scales, 6-8 in whorls encircling joints of branchlets. Flowers unisexual (monoecious), inconspicuous, female in small auxiliary clusters, male in small terminal spikes. Fruit a tiny, 1-seeded, winged nutlet (samara), formed in woody cone-like clusters (fruiting heads), these brown, to 2 cm (3/4 in) long and 1.3 cm (1/2 in) wide.

Flowers

It is a bisexual plant and are inconspicuous. Male flowers occur in cones, while the female flowers occur in groups and they are small. The flowering occurs two times in a year between February –April and September – October months. Male flowers produce blossom after two years of seedling but female flowers produce blossom after few days.

Wind pollination occurs in this plant.



Fruits

Fruit is very small, winged nut lets that each contains one seed. The fruits are contained in woody, cone-like structures that are 0.75 in. (2 cm) long. Ripening of fruits occurs during June and December. Fruits are globose, woody cones and ripe cones are grey or brownish red in colour, containing a number of winged achenes, each enclosing a solitary seed. Each cone contains 70 to 90 light brown colored seeds.



Foliage

Branchlets resemble as pine needles and they are very thin, 4 to 8 inches. (10 to 20 cm) long and greyish-green colour.



Bark

The bark is redish the bark is brown color, brittle, peeling.

**Leaves**

Leaves are reduced to tiny scales, six to eight in whorls (this is a distinguishing feature, see Similar Species), whorls encircle joints of branch lets.

**Seed**

Male and female plant are grown separately. Hence it is a dioecious plant. Of the total population, 56% of the plants are male, 42% of the plants are female and 2-3% of the plants are bisexual. Before dehiscent of ripen cones from trees, it can be collected from 5-6 years old age tree. The winged seeds can be shed and separated after drying them in the sun for 3-4 days. After separating of winged seeds, they can be dried again for 3-4 days.



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Ethanomedicinal Uses

Casuarina equisetifolia traditionally used for various types disease and disorder such as diabetic, hyperlipidemic, Astringent, diarrhoea, muscle weakness, gastric problems, microbial disease and nervous disorder. In the parts are medicinal used Aerial parts, root, seed.^{[3][4]}

Physicochemical Analysis of *Casuarina Equisetifolia* Stem Bark

To the wide use of herbal drugs in traditional medicine, standardization becomes an important role in to ensure the quality and purity of the crude drug. Physicochemical analysis performed in *Casuarina equisetifolia* it can serve as valuable source of information which is usually helpful in evaluation of purity and quality of *Casuarina equisetifolia* stem bark. The following parameters such as Loss on drying(2.3 ± 0.42), Total Ash value(5.0 ± 0.2), Acid insoluble ash(0.7 ± 0.028), water soluble ash(1.69 ± 0.35), sulphated ash(5.7 ± 0.53), these parameters ensure the purity of *Casuarina equisetifolia*.

Morphoanatomical Studies on Stem Bark of *Casuarina Equisetifolia*

Macroscopic Study of Stem Bark

Color; Ash grey to grayish-brown and internal surface light yellow to deep brown color.

Size; Channeled, Curved, Slightly quilled, Usually 0.2to8 cm thick.

Odour; Odourless

Taste; Astringent

Microscopic Study on Stem Bark

Transverse section study of the stem bark depicts that bark shows cork, Phellem, Phellogen Phellodermsecondary cortex, Phloem fibre, Phloem parenchyma, Stone cells.

Powder Analysis of Stem Bark

Stem bark powder appears brownish showing thick walled oval to polygonal cork cells, hexagonal phelloderm cells, rectangular thin walled cortex cells, thick walled elongated.

Phloem fibres, lignified stone cells and rhomboidal crystals of calcium oxalate.^{[23][24]}

Phytoconstituents

Qualitative Phytochemical analysis carried out by different parts of casuarina equisetifolia by using various solvent extract. The following secondary metabolite are present in a plant they are Alkaloids, phenoliccompounds, Tannins, flavonoids, glycosides, saponins, phytosterol, terpenoids.

Flavonoids Compound

Kaempferol, Quercetin, cupressuflavone, isoquercitrin, juglanin, nicotoflorin, rutin, hesperetin, narenginin

Alkaloids

Casuarine is only alkaloid present in plant, its chemically highly oxygenated pyrrolidine alkaloids.

Terpenoids Compound

The seventy six terpenoids compounds are identified in the leaf and fruit oil. Lupeol is a pentacyclic triterpenoid that is lupane in which the hydrogen at the 3beta position is substituted by a hydroxy group it has several potential medicinal properties monoterpenehydrocarbons(29.3%), oxygenatedmonoterpenoids(16.2%), sesquiterpene(29.3%), aliphatic(40%) The major compounds are pentadecanal(32.0%), 1,8-cineole(13.1%). Sesquiterpene are absent in fruits oils.the main constituents are caryophyllene-oxide(11.1%), translinalool oxide(11.5%), 1,8-cineole(9.7%).

Phytosterol Compound

Beta-sitosterol, cholesterol, stigmasterol, campesterol, cholest-5-en-3-beta-ol derivatives.

Phenolic Compounds

The following phenolic compounds are isolated from leaves fruits, bark extract they are Ellagic acid, gallic acid, catechin, epicatechin, proanthocyanidins, procatechuic, p-coumaric, chlorogenic, pyrogallol, Hydroquinone, protocatechuic, syringic, parahydroxybenzoic acid, salicylic acid, vanillic acid, Rosmarinic.^[5-11]

PHARMACOLOGICAL IMPORTANCE

Hypoglycemic Activity

Casuarina equisetifolia aerial parts and seed are traditionally used as antidiabetic treatment. Nowadays The hyperglycemic activity of casuarina equisetifolia ethanol extract of bark was evaluated against the streptozotocin induced in male Wistar rats. Blood glucose levels are diminished at the continue administration of ethanolic extract of casuarina equisetifolia in diabetic induced rats the blood glucose levels are reduced at the 7th day of after administration of ethanolic extract. In another study, Researchers investigated the antidiabetic effect of ethanolic extract of bark is carried out by streptozocin induced rats.^{[12][13]}

Antioxidant Activity

Casuarina equisetifolia have a potential Antioxidant activity it is due to the presence of phenolic compounds such as Tannins, flavanoids. The antioxidant activity is performed by the following method they are DPPH and FRAP. Antioxidant capacity was determined by various plants parts extracts such as leaf, wood, bark, root, fruits. The condensed tannins such as procyanidin extract from stem bark and root of casuarina equisetifolia have a good Free radical scavenging capacity. The antioxidant activity are compared with ascorbic acid and procyanidin, it show procyanidin have more antioxidant activity. This active constituents are may be used as new sources of natural antioxidant in pharmaceutical and nutraceutical products.^{[14][15]}

Antiinflammatory Activity

The different concentration of (20,40,60,80µg/ml) casuarina equisetifolia bark extracts show that antiinflammatory activity. The methanolic bark extract show the maximum inhibition when compared to ethanol and aqueous extract. The scientific investigations clearly indicates the

clinical efficacy of casuarina equisetifolia bark extract. The phytoconstituents of extract are suppress the release of inflammation mediators.^[16]

Antimicrobial Activity

The chemotherapy and antibiotics efficacy are reduced due to the resistance developed by several microorganism so that reason many of the researchers to find out the new lead moiety form plants extract. Therefore many of the studies validated the antimicrobial activity of aqueous, ethanolic extract of leaves, wood, bark and fruits of casuarina equisetifolia against microorganism such as bacteria, and fungi. Antimicrobial activity of aqueous and ethanolic extract of casuarina equisetifolia carried out by disc diffusion method. Leaves and Bark extracts are good anti microbial effect due to inhibit 100% growth of microorganism, the activity is tested against following micro organism such as *s.aureus*, *E.coli*, *B.substilis*, *P.vulgaris*, *aspergillus niger*. The Aspergillums Niger growth was effectively inhibit by ethanolic extract of *casuarina equisetifolia*. The antimicrobial potential of various plant parts extracts was such as root, stem, leaves, and bark of casuarina equestifolia is tested against six different species. Acetone extracts of *casuarina equisetifolia* show that maximum inhibition. The zone of inhibition was measured they are 29mm and 26mm respectively. where as ethanol and methanol extract showed the inhibitory activity the zone of inhibition was 16mm.^{[17][18]}

Anti Histamine Activity

The antihistamine activity of methanolic wood extract of casuarina equisetifolia is performed by clonidine induced catalepsy. Catalepsy is extra pyramidal effect due to inhibit the dopamine transmission or increase in the release of histamine. Interperitoneal administration of clonidine to the mice will be promote the histamine release finally it absorbed catalepsy in mice. Then after administrate ethanolic wood extract of *casuarina equisetifolia*, the histamine release decrease in clonidine induced catalepsy mice due to the mast cell stabilizing or antihistamine properties.^[19]

Heptoprotective Activity

To determine the pharmacological importance of *casuarina equestifolia* in heptoprotectivity. The heptoprotective activity was demonstrated at CCl₄ induced rat. In rats, ccl₄ was admistarted by interperitoneal injection. Once injected the CCl₄ it will be produce the liver damage in rats. Then the mthanolic extract of casuarina equestifolia was admistarted to rats by the route of interperitoneal injection the administration dose was 500mg/kg body weight.

Finally hepatoprotective activity was evaluated by biochemically and histopathologically. Treatment with methanol extract of *Casuarina equisetifolia* at dose of 500mg/kg body weight, showed in rats liver cells are protecting from CCl₄ injury.^{[20][21]}

Role of *Casuarina Equisetifolia* in Nanoparticles Synthesis

Nano technology is the newest and one of the most promising areas of research in modern science and technology. Metal nano particles show to enormous potential application in medicine, biology, material science, physics, chemistry, biological labeling.

Green Synthesis of Silver Nano Particles

The present work report, green synthesis of silver nanoparticles was synthesized from reducing agents of the medicinally valuable plant *Casuarina equisetifolia* leaves extract. The synthesized silver nanoparticles were confirmed by the change of colour, UV-visible of the SPR value at 425nm, FTIR Spectra and XRD analyses. From the HRTEM images, The Ag nanoparticles are spherical shape with size 14-50nm. The *Casuarina equisetifolia* leaf extract Phytochemical such as polyphenolic groups of tannin, kaempferol, catechin, and gallic acid seem to play role in reducing and stabilizing agents in the synthesized Ag nanoparticles.^[22]

CONCLUSION

Casuarina equisetifolia contained carbohydrates, alkaloids, proteins, glycosides, saponins, phenolics, flavonoids, tannins, steroids, gum, reducing sugars and triterpenoids. It exerted many pharmacological activities including antimicrobial, antidiabetic, antioxidant, cytotoxic, hypolipidemic, gastro protective, hepatoprotective and many other pharmacological effects. This paper will highlight the chemical constituents and pharmacological effects of *Casuarina equisetifolia*.

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